Mineral Physics Modeling of the Effect of Water on Crustal Seismic Velocity Ratios

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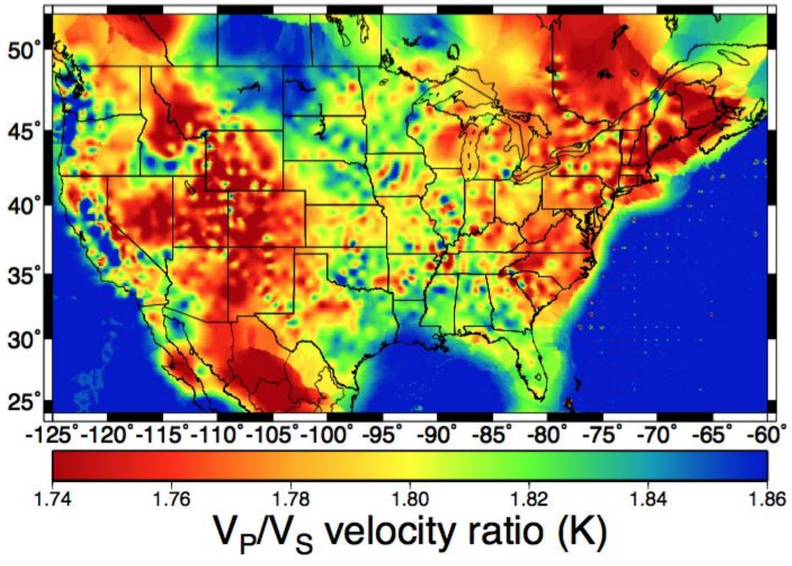
ABSTRACT

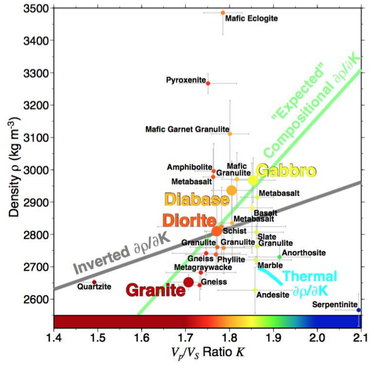
This poster presents the relationship between the presence of water (H_2O) in the make up of rocks at different levels in the crust. The relationships were calculated using Perple_x software to adjust the level of the different chemical and mineral make up of the rock. The densities were calculated using the velocity of primary waves and shear waves as collected by Tony Lowry. This study focuses primarily on quartz content. There seems to be at least a casual link between water content and quartz content.

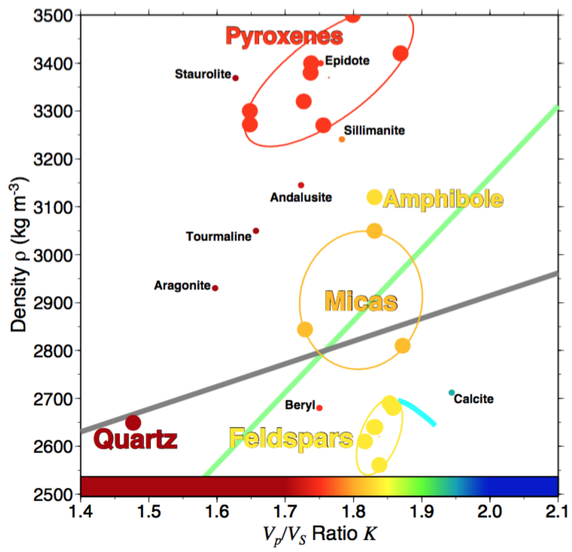
BACKGROUND



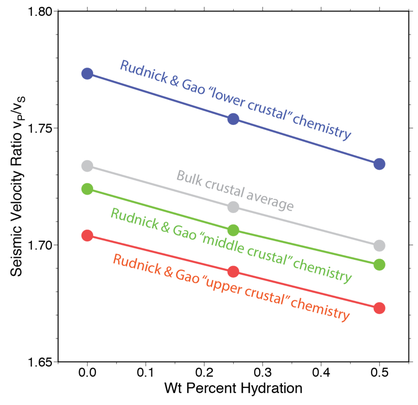
The picture above shows the Vp/Vs ratio in the United States. In the west there are spots where it is pretty low. This is in part due to the subducted oceanic plate under the continental crust.

On the right, we would expect the dp/dK line to be steeper. Because it is not we assume there are other things at play.





One of the biggest things that could change the ratio is the amount of quartz versus other minerals that could form. Guerri, et al implied that there was a relationship as well between the hydration and the Vp/Vs ratio.



METHODS

Depth (m)	Temp (K)	Pressure (bar)
5000	423.15	1397.925
10000	543.15	2795.85
15000	663.15	4193.775
20000	773.15	5591.7
25000	873.15	6989.625
30000	963.15	8387.55
35000	1043.15	9785.475
40000	1108.15	11183.4

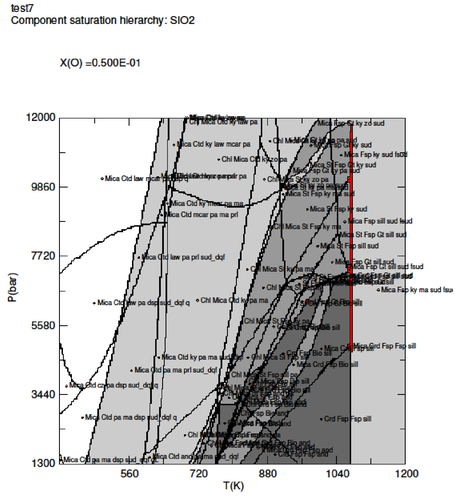
The pressures and temperatures in the table on the left were used to calculate the velocity profiles of the different minerals. Below, the weight percentages given by Rudnick and Gao were used to calculate what minerals formed in the presence water. The mineral percentage was calculated using Perple_x and the state equations from various authors that it contains.

Chemical comp.	Upper Crust (wt %)	Middle Crust (wt%)	Lower Crust (wt%)
Na_2O	3.27	3.39	2.65
MgO	2.48	3.59	7.24
Al_2O_3	15.4	15.00	16.90
SiO_2	66.62	63.50	53.40
K_2O	2.80	2.30	0.61
CaO	3.59	5.25	9.59
FeO	5.04	6.02	8.57

RESULTS

The software produced images of the state of the different mineral compositions such as the one on the right. This show all the different mineral types for different pressures and temperatures.

These results show that according to the software there is a relationship to the amount of water in the rocks and how much of the SiO_2 forms into quartz and how much forms into other substances. It appears that with more water there is less quartz.



It is important to note that when talking of hydration, this means elemental hydrogen and oxygen mixing in with the structure and not simply H_2O dispersed among the elements.

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